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ABSTRACT

This report analyzes the impact that technology has made on higher education in Australia, estimates the likely demand for technology by higher education in the future, raises a number of issues that derive from the impact that technology is having on society as well as on higher education, and makes recommendations on setting up bodies charged with the critical scrutiny of such impact. In this context, the present state of the art is examined and assumptions are developed that will determine the demand for technology. Diagrams depicting those factors influencing the impact of technology, the demand for it, and the prognosis for its use in future educational ventures under an open educational philosophy are included. (Author/RAO)

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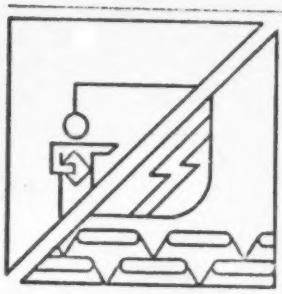

Technology Higher Education and the demand for Technological Artefacts to the year 2001

A submission to the
Myers Committee of Enquiry
into Technological Change
in Australia.

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CONCLUSIONS

1. Technological artefacts have had a limited effect on practices in higher education.

2. A large part of the demand for technology has been created by Commercial Push, not institutional demand.

3. Higher education is unlikely to be a large customer for component technology in the future. Where such a demand exists, it will be in the area of communications technology.

4. Commercial manufacturers and retailers must research the market demand for component technology before attempting to create a demand with supply.

5. An appropriate post secondary education body should set up a liaison group with commercial interests to identify the areas of need for technology and possible technical solutions.

6. A levy should be placed with a value sales tax on technological artefacts sold to educational institutions to finance detailed impact studies of such products.

7. There is evidence to show that there are second and third order effects which arise from the extensive use of technology; e.g. in particular, deskilling and unemployment. The potential impact of machines on man's social and work activities is yet to be assessed.

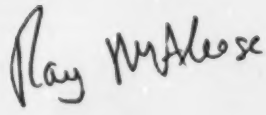
8. The federal government should consider setting up an Office of Technology Assessment to keep under review and promote investigations of the social and economic effects of technology.

9. The federal government should set up an independent Educational Council for Technology charged with assessing the contribution of audiovisual technology and technological artefacts on all levels of education.

ACKNOWLEDGEMENTS

The views in this submission reflect the thinking of many people. The following individuals have helped me synthesise the final assessments. Mr John Julian; Mrs Anne McDougall; Mr Ted Snell; Dr. Terry Dunn; Mr Cyril Driver; Dr. John Hedberg; Professor Alex Wearing; Dr. Peter Thorne; Dr. Jeff Malley; Dr. Jack Hoadley; Dr. Floyd Ausburn; Professor David Beswick. A number of others have helped with the preparation of the data and the submission. In particular Ms Suzie Boxshall who prepared the artwork, Mrs Cathy Horreau, and Ms Jan Smith who typed the manuscript.

While these people have contributed to the thinking and the preparation, the responsibility of the views in this submission rests solely with me.



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DATA SOURCES

The data upon which the assessments made in this submission are made reflect a wide range of sources. Some twenty individuals were interviewed using the answers to a structured questionnaire they had previously answered. A current and retrospective literature search was made through the AUSINET system of a number of international data bases. There were ERIC, NTIS, INSP, SSCI, Thesaurus descriptions used included: educational technology; technology assessment; computers; futures; social change; technology; technological advancement; communications; television; holograms; lasers; satellites; telephones. Dr. Jeff Malley (of Royal Melbourne Institute of Technology) and Mr John Julian (University of Melbourne) helped with specialised bibliographies.

In general the quality of future studies of education and in particular the impact of technology is very poor. Little conceptual development is apparent. Most studies are normative with a few deterministic. More general studies containing references to education are almost entirely non-Australian.

OBJECTIVE

This submission analyses the impact that technology has made on higher education in Australia and:

- estimates the likely demand for technological artefacts by higher education in the planned future, the near future and the distant future.

- raises a number of issues that derive from the impact that technology is having on society and more particularly on higher education.

- makes recommendations to the committee on the setting up of bodies charged with the critical scrutiny of technological impact on education and society.

To achieve these ends the submission will examine the present state of the art with regard to technology and develop the assumptions that will determine the demand for technology.

THE NATURE OF TECHNOLOGY IN HIGHER EDUCATION

This submission confines itself to a selected area of the Myers' Committee remit. The focus is higher education*: that is, universities, colleges of advanced technology, technical and further education institutions. Before looking at the present state of the art, it is wise to define carefully some initial assumptions.

Early man communicated with his colleagues, friends, children, etc. using a stick to draw ideograms in the sand. The microelectronics industry based on the silicon chip has at least a claim to be the decendant of this early form of communication based as it is on silica; sand to sand - the wheel turns full circle. (see for example Gosling, 1978.)

During the five millenia that it has taken man to progress from ideograms in the sand to electonic chips we have seen the growing impact of technology and technological artefacts on communication and teaching. During the last two decades education at all levels has had to respond to the stelthy attack by instructional technology and the full frontal assault by audiovisual aids. In education some have suggested that we are experiencing the most recent wave of attacks that may eventually test our assumptions about teaching and learning in education (see for example Burke's critique of the assumptions of the Committee of Enquiry into Computers in Education, in, Wearing, 1976). Early revolutions were: the movable type of Guttenburg; early audiovisual technology related to film in the early part of this century; computer based technology of the nineteen sixties; and now the microchip. Four waves of attack - or so it might seem. Other 'technologies' have made their impact on education. The concept of <u>educational or instructional technology</u> is now becoming central to the design and evaluation of instruction. However, such technology is systems oriented and not based on hardware or 'component technology' to any a great extent. Mitchell in an analysis of the concept 'technology' observes:

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* In a strict sense 'higher education' should refer only to universities and colleges of advanced education. However, as many of the assumptions and observations refer to <u>all</u> post-secondary education, (which in itself is the clumsy term), the term higher education is used throughout.

"it is clear that the influence of technology in shaping our lives, it is unsurpassed even if it is not clear what meaning is ascribed to the word". (Mitchell, 1975)

He goes on to develop a wide view of educational technology but in doing so suggests that:

"technology is more than tools techniques and processes it is a very human creative endeavor. Man is homo faber as well as homo sapiens ... man the maker as well as man the thinker". (Mitchell, 1976 quoting Goshen, 1970)

He concludes that educational technology is:

"concerned with all aspects of the organisation of educational systems and processes. (Educational technology) is a hybrid of education and technology ... rather than a simple grafting onto education of technological products". (Mitchell, 1975)

While it is more logical to take a systems view of technology than the rather restricted view that sees technology being only technical artefacts, this submission restricts itself to the narrow definition. The technical artefacts that have had, or may have an impact on higher education are: computers, television, satellites, laser-holograms, telephone technology including optical fibre transmission, word processors and micro graphics (microfiche etc.).

THE FUTURE OF HIGHER EDUCATION

As part of this submission is concerned with the future it is necessary to indicate the general nature of higher education that will or may exist sometime in the future. Assumptions are limited, but a backcloth is necessary. Many authors projected their visions of the future. Studies like the Borrie Report (1975); Hore, Linke and West, (1978); Emery et al, (1974); and Bain, (1974). Most recently the Williams Committee, (1979) has made projections at a Federal and State level into the future and it is likely that although at first sight this last report has been very conservative in approach it may well have structural effects that will effect the possible future of higher education. For example, the reimposition of fees, if that were decided on, would effect the take-up rate by lower socio-economic status mature students. Although there have been a wide variety of state and federal commissions on education only the

Karmel report on Open University Education (1975) makes an important contribution to the debate on technology. The Partridge Report on Victoria is non-committal with regard to technology; the Anderson Report makes passing note of the impact of educational technology in South Australia. (Partridge, 1978, Anderson, 1979)

Assumptions need be made however which will help determine the extent to which universities and colleges will need to be or will want to be dependent on technology. Assumptions made when writing this submission can be best summarised in a series of statements that reflect what is thought will or should happen by the year 2001.

1. There will be considerable collaboration and sharing of technical resources (e.g. computers) between institutions. In the same sector (university with university) and between sectors (universities and colleges of advanced education).

2. Institutions will find a significant part of their funds from outside of the present funding arrangements. This may well mean more contract research in universities with a drift towards more specialisation between research staff and teaching staff. In universities and other institutions, contract teaching of graduating, and non-graduating students will significantly increase.

3. Institutions will be run on management principles with less departmental authority and responsibility for funds and purchasing. Central bulk purchasing of equipment and materials will be co-ordinated between institutions.

4. Higher education will be much more "<u>open</u>", in two ways.

   (a) There will be an increase representation of what are called 'mature students' (i.e. aged more than 25). The present percentage of some 20% will increase significantly. This will happen to such an extent that institutions of higher education will become more separated from the primary/ secondary continuum. This is, there will be an increasing age gap between the normal and the mature entrants.

(b) The second assumption is that institutions will become involved on distance teaching to such an extent that a significant proportion of their funds are used for extension studies. It is this assumption that will have most effect on the take-up to technology. (see Table 1 and below for further detail). It is unlikely that such openness will occur in less than twenty years. Existing educational assumptions are still firmly held to and established.

These assumptions may well seem normative as opposed to deterministic (Hore, et al, 1978). This is recognized here as it is unlikely that higher education will evolve towards such a scenario without the help of positive or affirmative policies.

TECHNOLOGY AND HIGHER EDUCATION

This section of the submission contains the main discussion of the problems. After first looking at the issues from a general perspective, the impact and demand for technology are assessed. To achieve this, the conceptual models which underpin the conclusions are elaborated on and projections are made about likely futures and demands. First however a brief mention will be made of the techniques used in developing the main suggestions of this submission.

In essence the submission is a brief statement of the present position (established from a literature search (see Note) and a series of projections with comments on the likely future. The futurology study has lent itself to some non-standard educational research techniques such as scenarios and a modified Delphi technique (Rand, 1964; Hencley and Yates, 1974). Literature reviewed has provided the present state of the art and authors projections of likely futures. The later are scarce for Australia, although not so for other countries (e.g. Carnegie Commission on Higher Education, 1971 and Fragnière, et al, 1976). A range of expert opinion has been canvassed and some 20 expert witnesses have helped assess the probability of occurrences.

THE GENERAL POSITION

In general technology has had little accross the board impact on existing academic practice. The present situation may be summarised as follows:

Technology has had -

- little impact on an academic's ability to communicace, although chere is some evidence that learning patterns may have changed.

- quite a lot of impact on a teacher's capacity to organise teaching, research and administration; students have experienced some impact on their allocation of time between tasks.

- effected the time to prepare instruction both positively and negatively.

- effected the cost per unit of instruction and the cost per hour, (as above).

- little effect on the overall effectiveness (measured in learning gains).

- some effect on the nature and amount of social interaction between those in the learning milieu.

In the future, it is likely that technology will: extend the capacity of teachers, researchers and administrators; mean more individualisation of teaching/learning; alter further the work pattern for teachers and learners, but is unlikely to ease the workload for teachers and learners.

Little consideration has been given to date with regard to the social effects of technology. (However, see the section below.) It is likely that by the year 2001, considerable dissonant effects will be apparent. For example, deskilling, segmentation, man-machine ambivalence and structural unemployment. In general higher education has less to fear from these quarters than other sections of society. Nevertheless, in particular areas, notably research and administration, deskilling and unemployment may raise considerable problems.

THE IMPACT OF TECHNOLOGY

The impact that technology makes on higher education is a direct function of existing practice, that is, the usefulness of artefacts. Figure 1 is a schematic representation of the balancing forces that result in the impact or effect of the artefacts. The main positive forces are: Present Store

(the number of artefacts available), this in turn is determined by what may be best called Commercial Push. Figure 2 is a schematic representation of this important concept.

Normal commercial practice is to exploit goods and services to other industrial units and the general consumer public. This practice is governed by market research. In recent years the R & D sections of industrial concerns, have been seen to push their own products directly to the public (though the host commercial concern). A prime example would be the silicon chip. To achieve economies of scale, a major push was made to sell direct to the ecucational and general market. This was achieved by marketing the computing pocket calculator. A device based on existing silicon chips, not designed for a particular market need. (e.g. a device with alphanumeric input and non-erasable memory.) This exploitation of new technologies (often ill developed and seldom market researched as standard products are) is Commercial Push.

Educational catalysts, that is, educational technologists and instructional designers, operating with what knowledge they have, make a positive contribution. The third factor that increases demand is the availability of component technology. This is, the fact that an institution has a TV studio, will ensure that at least some of the time it will be used.

Operating against these forces are a cluster of powerful negative influences. Environmental and time table demands limit the use of non-standard teaching aids. Rooms are not suitable designed for projection or recording; timetables are not sufficiently flexible to permit individualisation of access to computers, calculators etc. Bottle necks occur which require detailed queueing analysis, over the supply of components.

Little is known of the long term effects of man-machine interactions. Problems exist which can be tackled by ergonomic experts, however, the ambivalent relationship which exists between man and machines is a strong disincentive for extensive use of machines. An example of this is in the area of man-computer interface. VDU screens have created eye strain; keyboards limit data input to those with the appropriate motor skills.

What evidence there is suggests that strong aptitude-treatment interactions exist. The application of individual components technologies to different learners, produces differential learning gains. For example, with regard to visual acuity and motor skills.

Software is most often criticised for its quality. Technical developments have far exceeded that conceptualisation and production of good software. As a result many artefacts are emasculated of their potential use by inappropriate software. Computer and television related technologues are most prone to this criticism.

The academic reward structure, particularly in universities does not benefit the exploitation of hardware (or software) by academics. Traditional basic research, the stamp of academic approval, is reliant on technology, but in such a way that its demand is not direct, but through the process of research methodology. Little reward (in terms of tenure, promotion) are given for the exploitation of component technology (e.g. CCTV).

By far the most important factor is what McAleese, (1978) has called institutional homeostasis. That is the natural (and to some) proper resistance to change by an organism. This can be seen as having five aspects:

Not Inverted Here: Unless the artefact or software was produced in an institution, it is not used.

Dependence: A liking for one piece of favourite, but out of date, equipment.

Conformity: Claims that such a change would be against normal functioning, operating practice, etc.

Vested Interests: A new technology challenges the social organisation and alters the interests of users of 'old' technology.

Socioscanct: Some things are so standard that a change is like altering a fundamental rule of nature. For example, the use of secretaries to take dictation.

Such forces, acting in a complex way achieve an organic balance in such a way that determines the impact of any technology. In essence, Commercial Push can be seen as operating through the Existing Stock in opposition to Institutional Homeostasis.

THE DEMAND FOR TECHNICAL ARTEFACTS

In general the main demand for technical artefacts has come as a result of Commercial Push (see Figure 2). However as with the impact of technology, the resultant demand is a balance between competing forces. Four factors influence the demand positively. Commercial Push has been referred to above. The effectiveness of any artefact in achieving an end is a positive force. This has two components, one related to cost saving and the other to capacity extension. Where a technical artefact can achieve a cost saving result (e.g. a word processor), then its demand is positively effected. In some cases existing practice and capacity is extended (with or without cost savings) for example with simulation and modelling procedures undertaken by computers. In general, technology can be thought of as extending four types of skills. (see Table 3) Each skill or facility (e.g. storage) is effected by different technologies. Computer related technologies extend more skills than other technologies.

Individual research and development projects have made positive effects with application of micro-processor technology. For example, the use of computer technology in machine control and in specific areas, such as time compressed speech there have been positive effects.

Educational opportunism, while it has a positive effect, may not be entirely desirable. It is the demand for 'in' gadgets or artefacts. A particularly good example of what may be called riding the educational wave was the demand for CCTV in the early 70's.

Acting against these forces are two main forces. Institutional homeostasis, referred to above, and knowledge about the effectiveness of artefacts. Little knowledge is open to operationalization and is available about the effectiveness of artefacts. Indeed such knowledge is unlikely to acrue as it has to be related to use. Where such evidence exists, it is probabilistic and conditional.

The resultant demand for technical artefacts has meant a bouyant market in certain areas (e.g. computers) with a demand potential in others (communications).

THE IMPACT AND DEMAND FOR TECHNOLOGY

Figures 4 and 5 summarise the qualitative assessment of the impact of technology and the likely demand for it. No attempt has been made to quantify either the impact or the demand. Although it is feasible that demand could be quantified given certain assumptions about stock and growtn, this sensitivity analysis has not been possible in the time available. Each figure represents the processes or artefacts that are judged and the time periods and categories for judgement. In each case activities in higher education are broken down into six closely related clusters. Teaching; Learning (difficult to separate in most cases); Research; and Administration represent the usual classification. The library standing or it does at the centre of the teaching learning process, is taken separately and sub-divided into a teaching/learning/research function and an administrative function. Giving in all, six categories.

IMPACT OF TECHNOLOGY

Figure 4 is the submission assessment of the contribution that technological artefacts have made with respect to cost saving and capacity extension facilities. And the use made of the processes or artefacts tested. In this table, existing education covers the period 1979 - 2001. That is under present educational philosophy. Future (open) Education refers to a likely future remains where education could be defined as more open. Table 1 summarises the assumptions made for Open education. This important scenario is both as result and resultant on a take-off in communication related technology in higher education (as well as the other factors mentioned).

Computer related technology is divided into computer assisted learning (CAL) computer managed learning; data storage handling and retrieval, word processing and the use of consumer electrones (i.e. non programmable hand or desk calculators).

Under existing educational assumptions the most significant contributions have come in the area of fundamental research through data handling and word processing. Although some use is made of large computer related

systems (PLATO; SOCRATES; TICCIT) in other countries (North America) little use is made or will be made in these areas. With regard to CAL and CML although some use will be made of these techniques, CML is likely to extend the teachers capacity, while in library appreciation there may be some use of CAL to extend the meagre resources of reader services divisions.

In the future, it is likely that the most significant impact will come from data handling and word processing in the areas of research and administration.

DEMAND FOR TECHNOLOGY

Figure 5 represents the assessment of the demand for various technical artefacts. Two assessments are made. Whether the demand is increasing, steady or decreasing and the level of the demand. If is the latter that requires a little detail.

Attempts were made to derive demand functions for various items by using present expenditure. Mainly due to the lack of precision in the demand equations and partly the lack of time, this exercise was not completed. The quantification is therefore very soft i.e. in terms of non-numeric terms. However, it was felt that the committee may not be interested in numbers of items or expenditure but on a more general concept of quantity. An indication of the size of the concepts might be given for comparison only. At present there are some 155 macro or main frame type computers in universities and about 50 in CAE and TAFE institutions. This represents the quantification "Many" for Main Frame Mini/ - Research and Administrative uses. (Figure 5, 1st, 2nd row)

Demand indicated in this way is a measure of the likely market demand that a comparent technology industry would have to meet.

TECHNOLOGY AND SOCIETY

Just as when a stone is thrown into a pool and ripples spread out from the epicentre, so the adoption of a technical aid or tool has effects that differ in order. First order (main effect); second order (main side effect); third order, and so on. (See Table 2).

In considering the impact that technologies make, it is necessary to go beyond simple cost and capacity extension criteria (that is first order effects). It would seem that the global concept of efficiency governs the decisions to produce, distribute, buy or use technical artefacts. The promotion and use of any technology has second order effects that relate not only to use but to wider contexts (e.g. unemployment, deskilling etc.). Second order effects can be roughly grouped into two clusters, Teacher/ Learner issues and Social issues. Technological artefacts have an impact in this way not only on institutions but on society as a whole. Third order effects can be classified as: psychological; organisational; ergonomical; ethical; social and economical (clearly some of these overlap with each other, and some with other effects, e.g. cost, they nevertheless indicate the extent of the forces at work).

Figure 6 is a schematic representation of the forces and factors that impact teaching/learning issues in institutions and society in general. The scheme can be summarised as follows: The use of technological artefacts by higher education and more generally be society leads to a number of secondary effects from thos intended. These second order effects can be grouped under a number of headings, fifteen in all.

Technology has created the situation where learning and working can be almost entirely individualised. The learner can be "attached" via communication network links to teachers many miles away. It is a possible scenario to have learners having little or no personal, face to face contact with other learners; either because of distance, or because of the extension of technology into homes. This may not in itself be a bad thing. However, the scenario of the 'long distance lonely learner' is one that should be considered. Learning in many cases is a co-operative activity. Requiring not only cross-referencing and assimilation, but articulation and feedback from other learners. While such articulation and co-operative goal structures are not the only format possible, the loss of such interaction may adversely effect learning.

To some extent the use of technology may be seen to be elitist. The technocrat has been at times given an elevated social position, in particular, when natural resources are scarce. The technocratic teacher, with a command of hardware and facilities may be positively advantaged over less technically oriented colleagues. Assumptions about elitism depend on the values given to technocratic activities by society. In

institutions there is evidence that the sciences with their technological underpinnings are seen to be more elitist than disciplines with little investment in hardware (e.g. the social sciences). Elitism may be seen to be ethical in underpinnings, although there may be minor social and psychological third order effects.

The use of technology can be a trap in that it may be impossible to return to a non-technological position after using a particular technology. For example we could not re-introduce copy typists after a period of disillusionment with word processors. As yet technology is an example of a good which exhibits increasing marginal returns. Not only has the rate of increase of technology (i.e. its adoption by man for problem solving) been exponential and therefore exhibiting increasing marginal returns, but because the marginal return in time period two is considerably greater than in time period one it is uneconomical and to return to a starting position. Figure 7 is a representation of this phenomenon. We achieve increasing returns out of unit imput from technology over time (i.e. $t_2 - t_1 = t_4 - t_3$ & $p_4 - p_3 > p_2 - p_1$). There are few examples of a technology of a technology being rejected in favour of an earlier non-technological solution. As result there is a technological momentum that keeps the demand for newer technologies bouyant.

Technology has effects on leisure as it allows us to achieve increasing marginal returns and unless there is a state of zero on diminishing economic growth then with such conditions the time taken to produce any product will decline forcing people to work shorter hours. Itself this may be in the long run a positive feature to our investment in technology; however the creative use of leisure time and a positive approach to non-work time is not common. This is particularly true among less skilled operators who are often the first replaced by technology. In higher education the reduction in working time may be of less a problem for academic staff who traditionally spend a proportion of their out of work time increasing their professional development in research and publishing activities. The increase in leisure time is strong in its tertiary effects as these are social effects on the family of workers as well as workers themselves.

There are strong unemployment effects with the use of technology. In higher education the area that is most prone to this effect is with clerical and basic secretarial skills. It has been suggested that the introduction of

word processing equipment could make between 30% and 50% saving in staffing. This reflects the proportion of time allocated by secretaries to jobs easily undertaken by word processing; e.g. letter copying; repetitive letters to many individuals; updating of reports. Several other areas exist where major savings may be made e.g. repetitive scientific analysis; manual cataloging; filing of documents. In general it is thought by those questioned that unemployment effects may be very strong; however in the short run at least it is likely that role differentiation and increasing specialisation will mop us spare capacity created by technological implementation.

Many other social effects are apparent with the use of technology. Economists are unsure if investment in technology can be quantitatively shown to contribute to 'measured economic wealth'. (e.g. Tobin). Many instances occur where computers may be used to invade the privacy of individuals. The illicit combination of computer files by an institution may pose a threat to individuals in cases where employment, and social data are kept. This raises the question of the ethics of use or misuse of comparent technology; in particular the computer.

Many examples have been identified of where researchers and administrators operate a practice that is less than desirable (for educational, logical reasons) but where 'over-riding' technical reasons determine the practice. People have to be trained to operate machinery yet little is known of man-machine ergonomics.

Last, but not least, because of man-machine interface problems, there are instances of psychological disassociation because of the failure of operators to control "that machine".

This list of social problems only indicates the magnitude of the problem. Claims that social effects are not important do not stand up to scrutiny. However as this section indicates, a lot more thought will have to go into this area before we can be more confident that the balance is in favour of a technological fate.

Figure 1:

Factors Influencing the Impact of Technology.

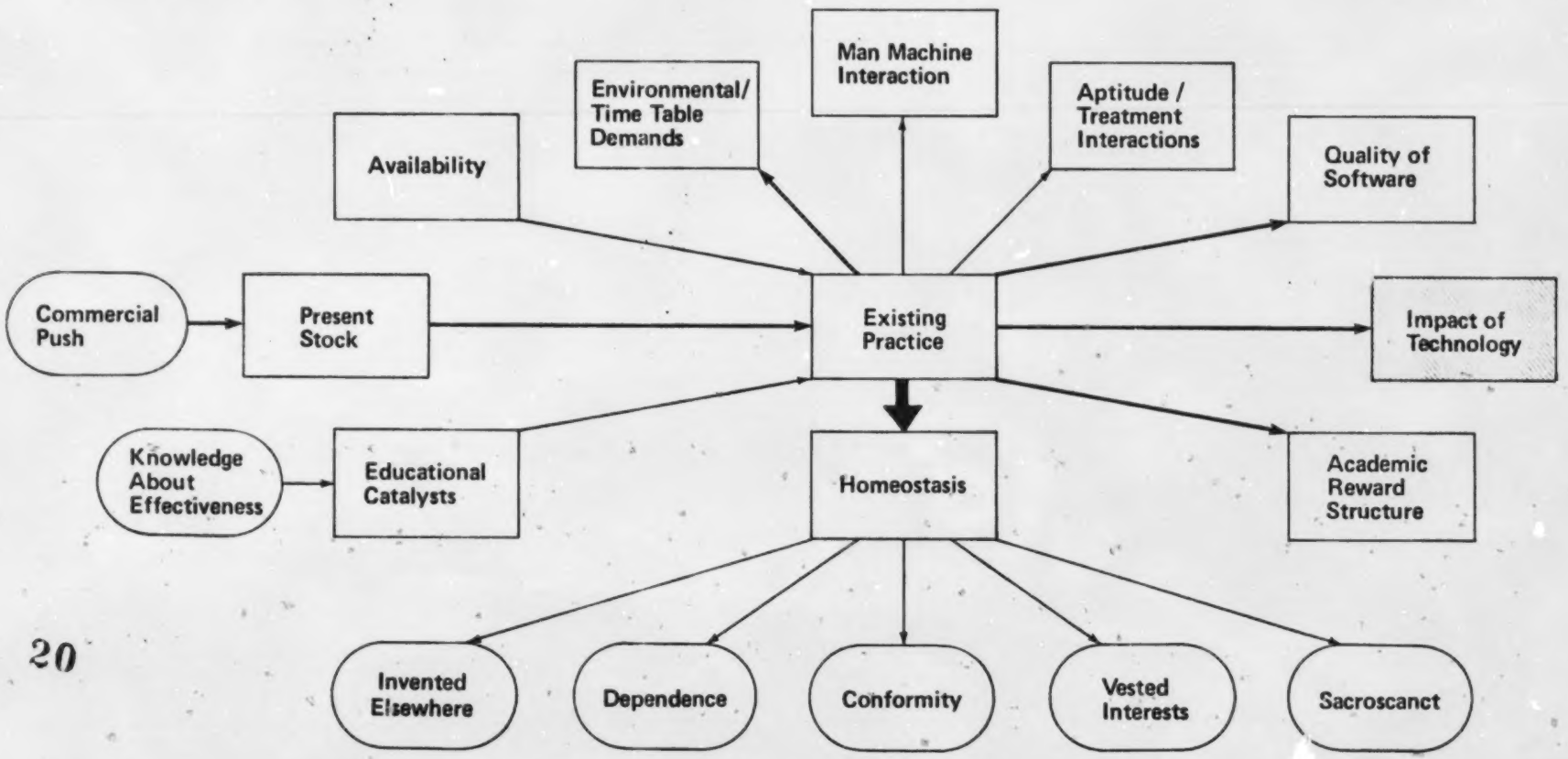


Figure 2:

Commercial Push

(Research and Development)
Exploitation of industrial research and development to increase normal demand.

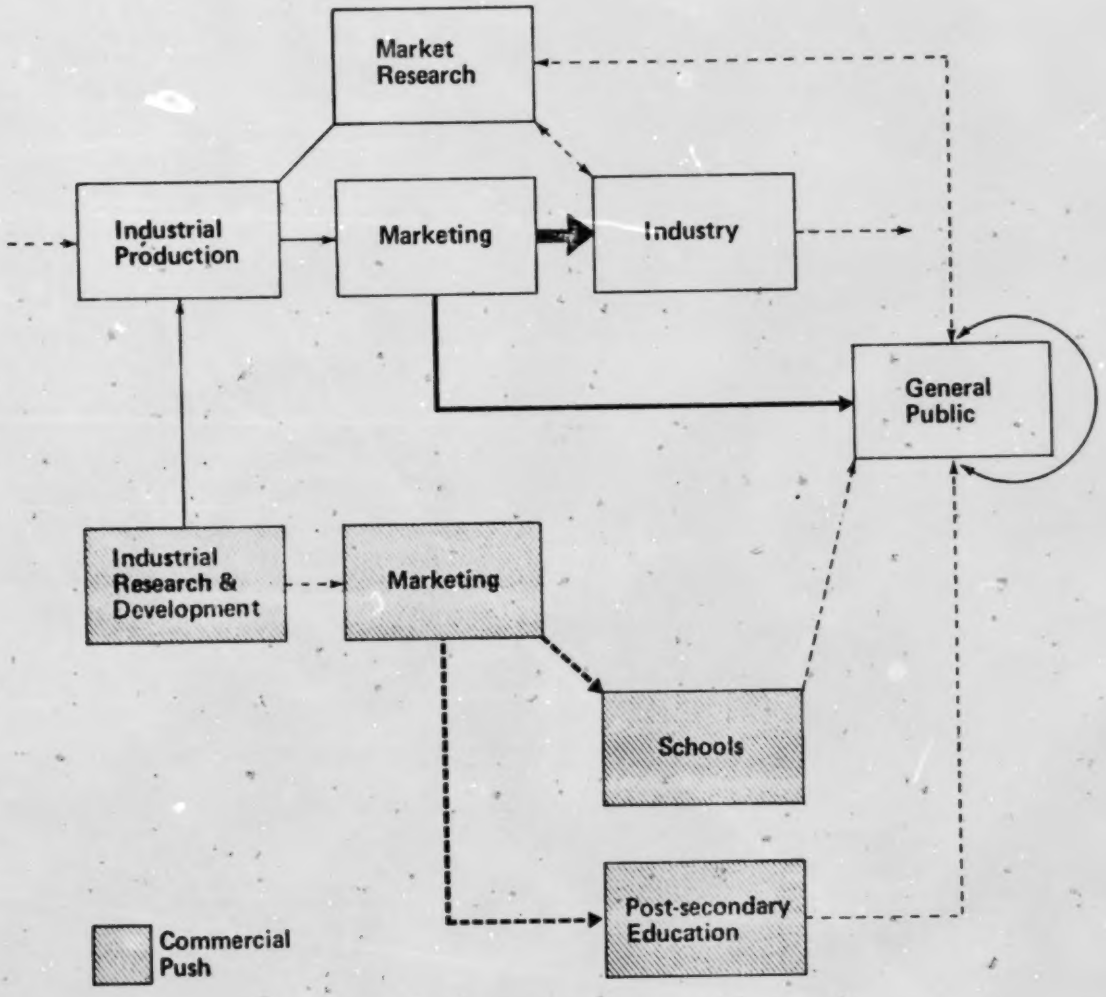


Figure 3:

Factors Influencing the Demand for Technological Artefacts.

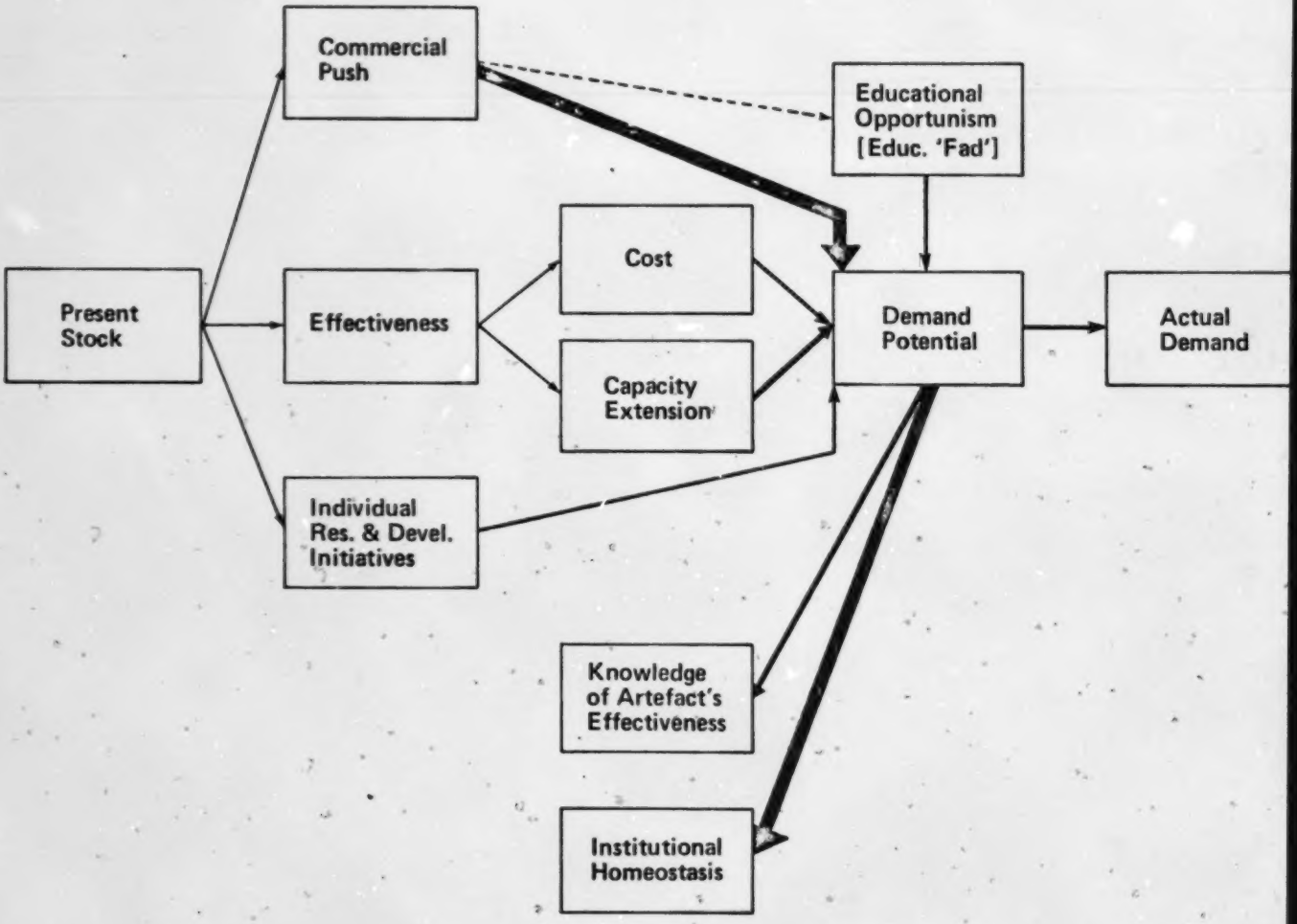
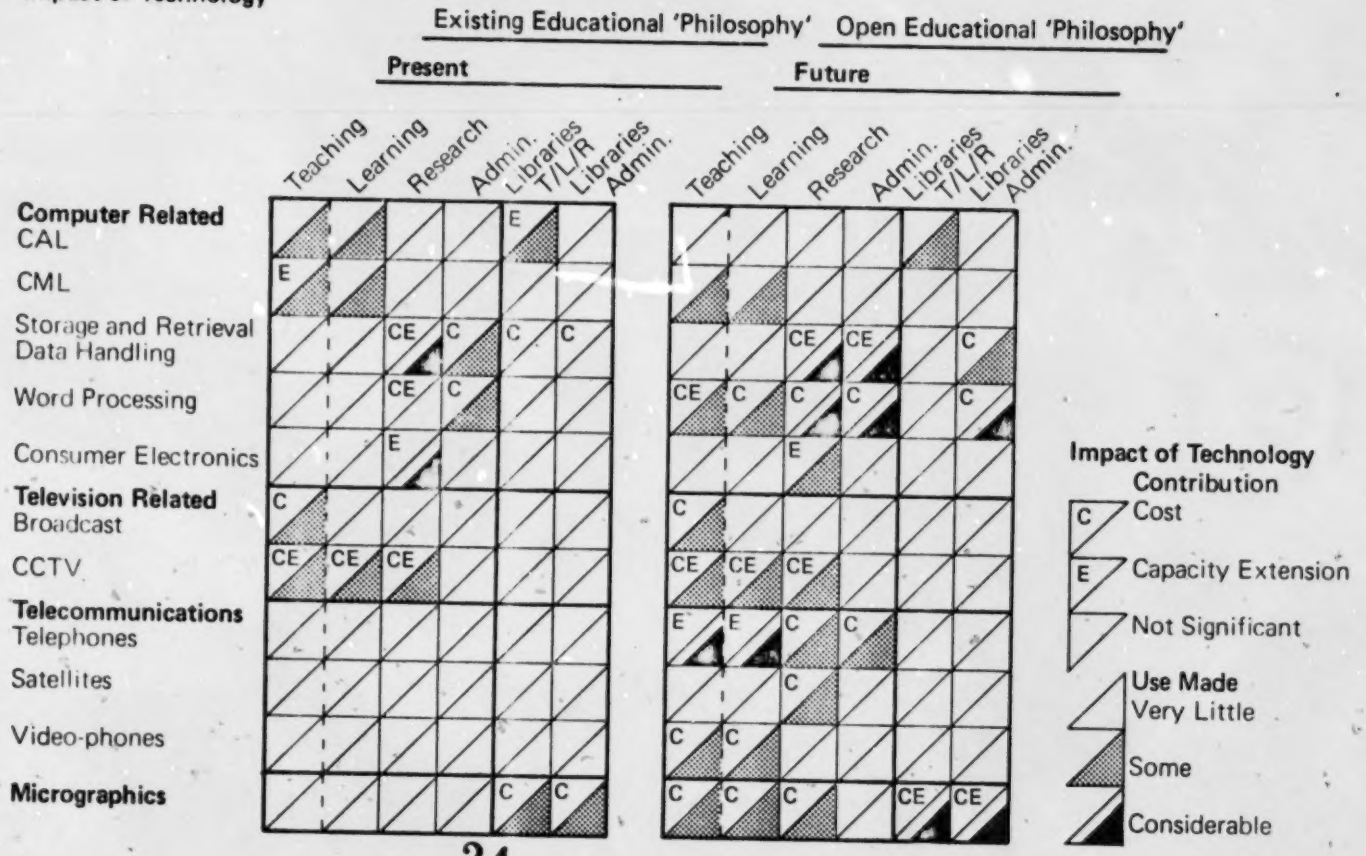


Figure 4:

Impact of Technology



Demand for Technology

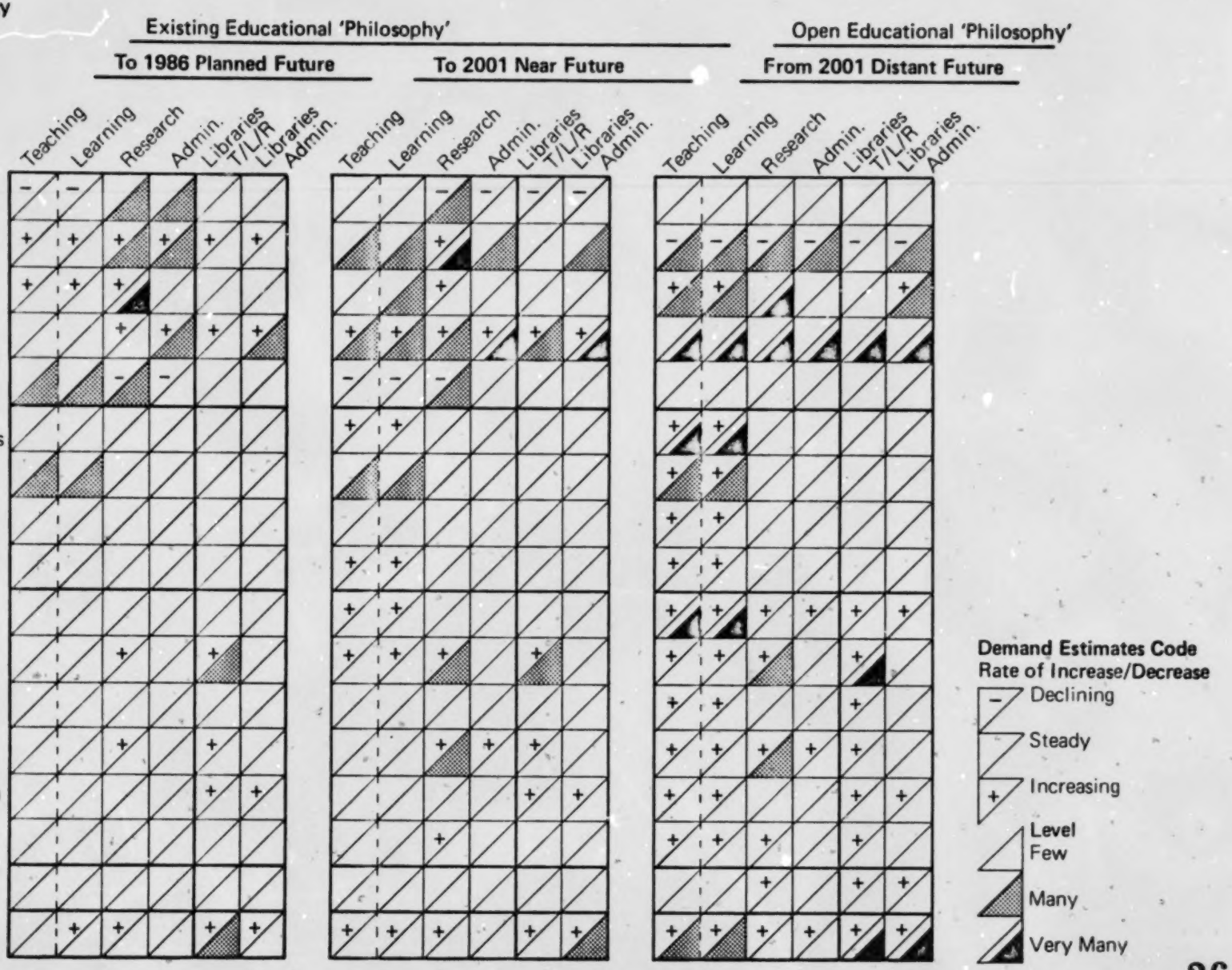
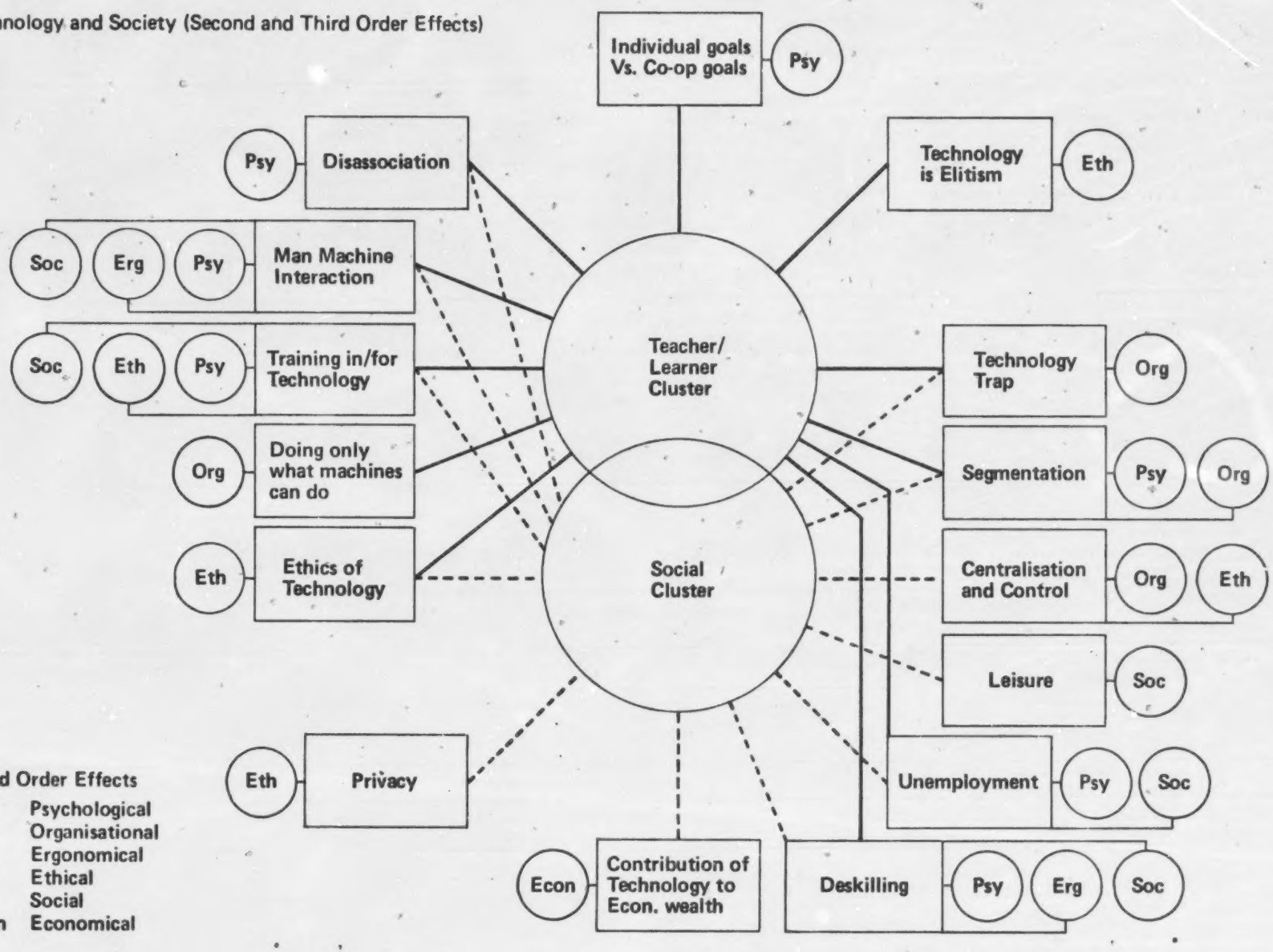


Figure 6:

Technology and Society (Second and Third Order Effects)



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Third Order Effects

Psy	Psychological
Org	Organisational
Erg	Ergonomical
Eth	Ethical
Soc	Social
Econ	Economical

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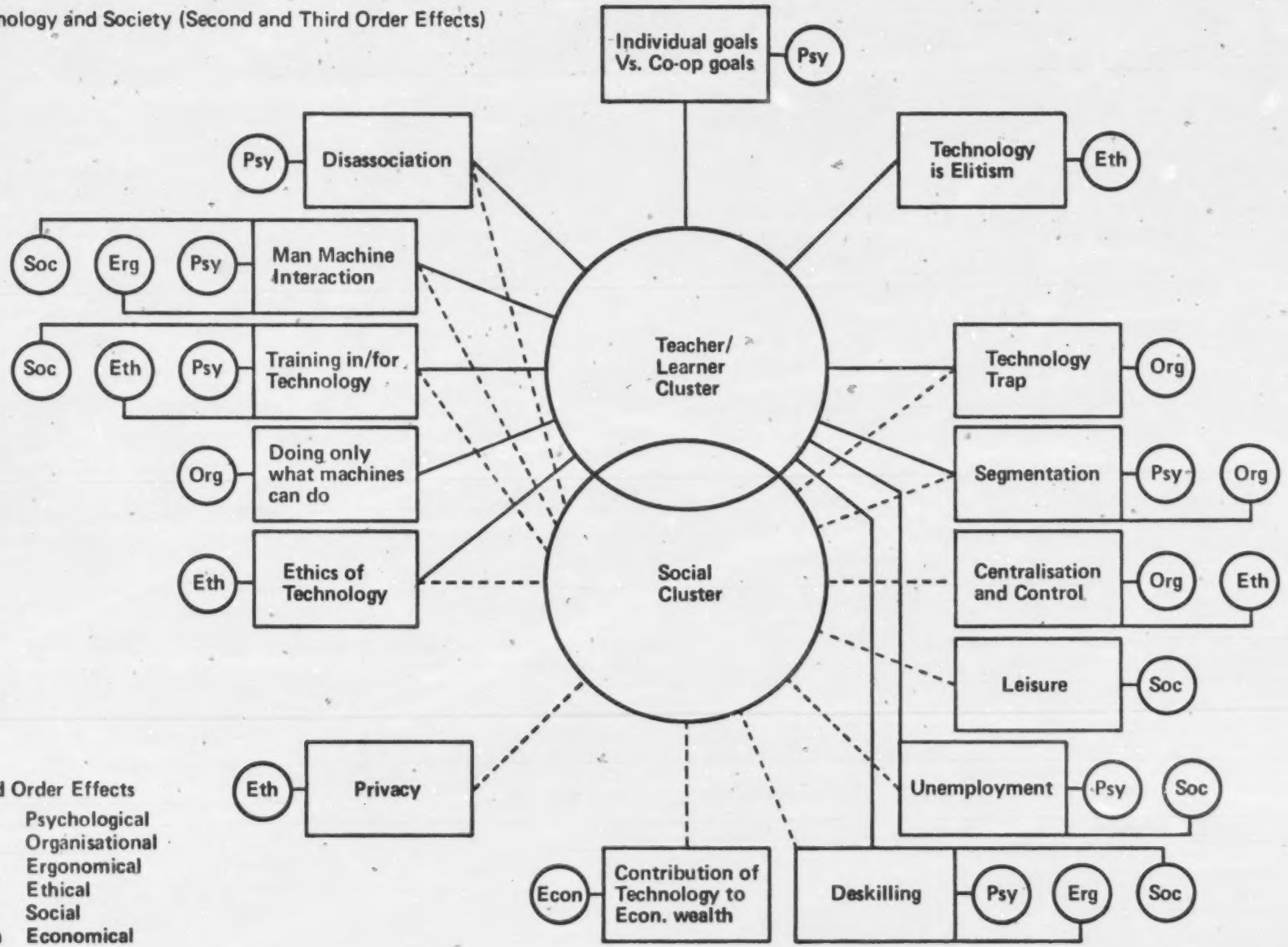
Technology and Society (Second and Third Order Effects)

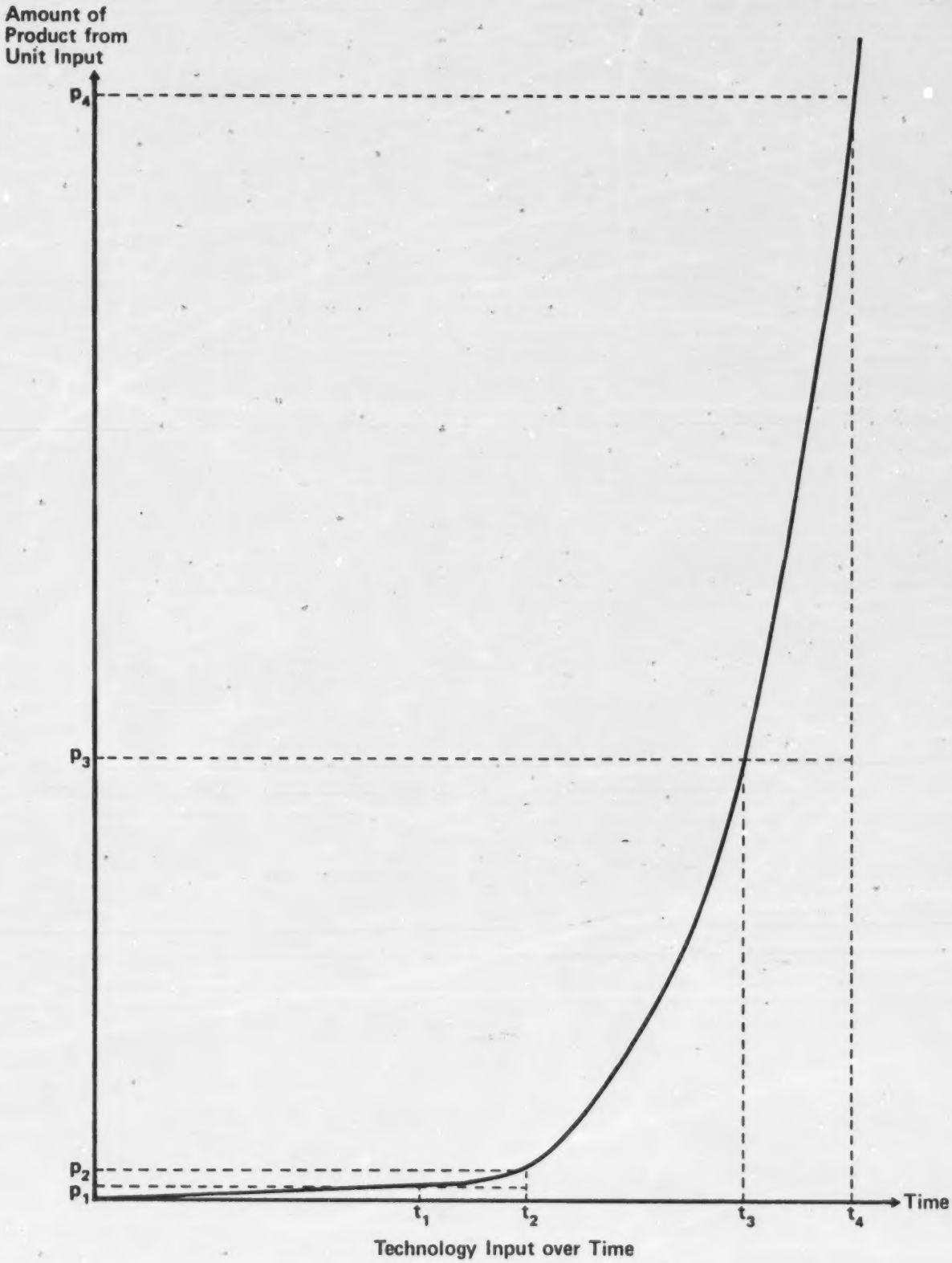


Third Order Effects

Psy	Psychological
Org	Organisational
Erg	Ergonomical
Eth	Ethical
Soc	Social
Econ	Economical

Figure 7:

Technology Trap



Available to all
Open to all
At any time during lifetime
Consisting of short courses
Unitised teaching
Open to scrutiny
Open to government intervention
Open to innovative educational methods
A heavy user of communication technology

TABLE 1: OPEN EDUCATIONAL PHILOSOPHY

FIRST ORDER	Cost savings
	Capacity extension
SECOND ORDER	Disassociation
	Goal structure
	Elitism
	Technology Trap
	Segmentation
	Centralisation and Control
	Leisure
	Unemployment
	Deskilling
	Economic Wealth
	Privacy
	Ethics
	Railroading
	Indoctrination
	Man-machine interactions
THIRD ORDER	Psychological
	Organisational
	Ergonomical
	Ethical
	Social
	Economical

TABLE 2: FIRST, SECOND AND THIRD ORDER EFFECTS OF TECHNOLOGY

Skills, Facilities	Technology
Storage	Computer Related CCTV Laser Holograms Micrographics
Manipulation	Computer Related CCTV
Retrieval	Computer Related Micrographics
Communication	Television Related Telecommunication Related

TABLE 3: SKILLS EXTENDED BY THE USE OF TECHNOLOGY